CLAIMS

1. – 52. (CANCELLED)

53. (CURRENTLY AMENDED) A method of estimating arterial delay and arterial dispersion (t, α, σ) values for outputting blood perfusion indices for a region of interest (ROI) by from operating a computer program on intensity data in input to a computer comprising:

a. using a computer to apply ~~applying~~ a first gamma-variate function (GVF) to an arterial input function (AIF_a) using a computer to provide an estimated first model of a vascular transport function $h_a(t)$, wherein for $t < t_1$, $h_a(t) = 0$ and for $t \geq t_1$, $h_a(t) = \dfrac{1}{\sigma_1}(t-t_1)^{\alpha_1} e^{-(t-t_1)/\sigma_1}$, wherein ~~an estimated~~ t_1 is the transit time of a contrast agent from a measured initial said AIF_a to a region of interest (ROI) and σ_1 is an estimating an initial delay value of said contrast agent, wherein said $\sigma_1=(t_1)(\beta_1)/(1-\beta_1)$, wherein said β_1 is a known relative dispersion value having a range from 0 to 1;

~~b. estimating an initial value σ_1 of said contrast agent, wherein said $\sigma_1=(t_1)(\beta_1)/(1-\beta_1)$, wherein said β_1 is a known relative dispersion value having a range from 0 to 1;~~

b. using a computer to convolve ~~convolving~~ $AIF_a(t)$ with said ~~$h_a(t, \alpha_1=0)$~~ $h_a(t)$ with $\alpha_1=0$ using a computer for obtaining an arterial input function $AIF_t(t) = AIF_a(t) \otimes$ ~~$h_a(t, \alpha_1=0)$~~ $h_a(t)$ with $\alpha_1=0$ at said ROI;

c. using a computer to estimate ~~estimating~~ a blood flow rate F_t and a tissue impulse residue function $R_e(t)$ using a computer by deconvolving a

concentration curve $C(t) = (F_t/k_H)AIF_t(t) \otimes R_e(t)$, wherein k_H is a ~~hermocrit~~ hermatocrit correction constant having a known value; ~~and~~

d. using a computer to optimize said mean transit time and dispersion (t_2, α_2, σ_2) values using a least squares method; and

e. using a computer to output said ~~outputting~~ estimated and optimized tissue mean transit time and dispersion (t_2, α_2, σ_2) values from an estimated transport function $h_e(t)$ for input to a simulated transport function $h_s(t)$, wherein a simulated tissue impulse residue function $R_s(t)$ is determined, wherein a simulated concentration curve $C_s(t)$ is fitted to said measured $C(t)$ and quantitative said blood perfusion indices are calculated, wherein each said step is performed by a suitably programmed computer.

54. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said intensity data is generated by administering a contrast agent to a body lumen of a body during a dynamic imaging scan, wherein said body lumen comprises an artery or vein, wherein an image response from said contrast agent is recorded to computer data storage in a computer.

55. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said $C(t)$ is a temporal concentration of said contrast agent obtained from said intensity data, wherein said intensity data comprises contrast images sequentially acquired from a region in a body, whereby said contrast agent concentration is plotted versus time.

56. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said AIF_a is based on a measured early arrival contrast agent peak intensity from a feeding blood vessel to said ROI.

57. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said AIF_a is scaled upward according to a venous input function (VIF), wherein said VIF is based on a measured late arrival contrast agent peak intensity from a large vein draining from said ROI.

58. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said estimated transit time t_1 is the transit time of said contrast agent from a measured initial said AIF_a of said contrast agent C(t) in a body lumen to said ROI, wherein said t_1 is estimated from plots of said AIF_a versus time and said C(t) versus time.

59. (CURRENTLY AMENDED) The method of claim 53, wherein said $h_a(t)$ is calculated using said estimated transit time t_1 and said estimated dispersion value σ_1, wherein ~~$h_a(t, \alpha_1=0)$~~ $h_a(t)$ with $\alpha_1=0$ is plotted versus time.

60. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said estimated transport function $h_e(t)$ is calculated using the relation $h_e(t) = -dR_e(t)/dt$.

61. (CURRENTLY AMENDED) The method of claim 53, wherein said tissue mean transit time and dispersion (t_2, α_2, σ_2) values are estimated from said estimated transport function $h_e(t)$, wherein said t_2, said σ_2 and said α_2 are input to a simulated transport function $h_s(t)$, wherein said $h_s(t)$ is ~~said~~ a second gamma-variate function.

62. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said simulated tissue impulse resistive function $R_s(t)$ is determined using the relation $R_s(t) = 1 - \int_0^t h_s(\tau)d\tau$.

63. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said simulated concentration curve $C_s(t)$ is determined using the relation $C_s(t) = (F_t/k_H)AIF_t(t) \otimes R_e(t) = (F_t/k_H) \int_0^t AIF_t(t)\, R_t(t-\tau)d\tau$.

64. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said F_t, said t_1, said σ_1, said α_2, said t_2, said α_2, and said σ_2 are optimized by a least squares method to fit said $C_s(t)$ to said $C(t)$.

65. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said perfusion indices have the relations:

f. blood flow (BF) = F_t;

g. Mean Transit Time (MTT) = $t_2 + \sigma_2(1+\alpha_2)$;

h. Blood Volume (BV) = BF * MTT;

i. Arterial Delay (DT) = $t_1 + \sigma_1(1+\alpha_1)$;

j. Arterial Dispersion time (ADT) = $\sigma_1 \sqrt{1+\alpha_1}$;

k. Tissue Dispersion Time (TDT) = $\sigma_2 \sqrt{1+\alpha_2}$;

l. Relative Arterial Dispersion (RAD) = ADT/DT; and

m. Relative Tissue Dispersion (RTD) = TDT/MTT.

66. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said $AIF_t(t)$ is measureable in a small lumen showing a delay relative to said $AIF_a(t)$, wherein optimized values for said σ_1 and said t_1 are determined by fitting said simulated $AIF_t(t)$ to said measured $AIF_t(t)$, wherein said relative dispersion β_1 is determined and applied to all other said intensity data of said ROI using said β_1, wherein a more robust fitting process is provided by a reduced number of parameters for optimization.

67. (PREVIOUSLY PRESENTED) The method of claim 66, wherein when said relative dispersion β_1 is determined, said vascular transport function $h_a(t)$ is described by a single variable said t_1 with a constant said β_1, wherein a two-step method is used to determine said delay and said dispersion values comprising:

a. deriving an initial tissue impulse residue function $R_0(t)$ by deconvolving $C(t) = (F_0/k_H)AIF_a(t) \otimes R_0(t)$ using a model-free singular

value decomposition (SVD) method, wherein said time delay t_1 is determined by a maximum position of said $R_0(t)$ at $R_{0\,max}(t=t_1)$; and

b. determine said $AIF_t(t)$ at an input of said ROI using said $h_a(t)$ with said t_1 and said β_1 held constant, wherein said σ_1 is determined.

68. (PREVIOUSLY PRESENTED) The method of claim 67, wherein a value of tissue blood flow F_t and a corrected impulse residue function $R_e(t)$ are obtained by deconvolving $C(t) = (F_t/k_H)AIF_t(t) \otimes R_e(t)$ using said SVD method, wherein said perfusion indices are determined from a curve of said $R_e(t)$, wherein MTT= $\int_0^\infty R_e(\tau)d\tau$, BF=$F_t$, and BV=BF*MTT.

69. (PREVIOUSLY PRESENTED) The method of claim 53, wherein said contrast agent is in a tissue ROI having a tissue mean transit time τ, wherein a tissue impulse residue function is approximated by the relation $R(t > \tau) = Ee^{-k(t-\tau)}$ and $R(t \leq \tau) = 1$, wherein E is an extraction fraction of said contrast agent in said tissue, wherein k is a constant clearance rate of said contrast agent diffusing from said tissue having a relation $k = E*F_t/V_e$, wherein $V_e$is the volume fraction of extravascular and extracellular space (EES) in said tissue.

70. (PREVIOUSLY PRESENTED) The method of claim 69, wherein said tissue impulse residue function $R_s(t)$ of said simulated concentration curve $C_s(t)$ is replaced by an average impulse residue function that incorporates

said contrast agent leaked out of a blood vessel into said tissue and gradually clearing from said tissue, wherein said simulated concentration curve $C_s(t)$ is fitted to said measured $C(t)$ and quantitative said blood perfusion indices are calculated, wherein said E and said V_e are additional parameters optimized with other adjustable parameters using a least squares method.